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Smedskjær, Morten Mattrup; Yue, Yuanzheng

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PERCOLATIVE INWARD DIFFUSION IN IRON-BEARING DIOPSIDE GLASS-CERAMICS

Morten M. Smedskjaer*, Yuanzheng Yue

Section of Chemistry, Aalborg University, Sohngaardsholmsvej 57, DK-9000 Aalborg, Denmark – morten04@bio.aau.dk

The so-called inward cationic diffusion is a diffusion process of network-modifying cations from the surface towards the interior of a glass. The diffusion occurs due to the reduction of polyvalent ions. In this work, we have shown that the inward diffusion degree of divalent cations decreases with increasing degree of crystallization in iron-containing diopside glass-ceramics, especially when the degree of crystallization is above 80 vol%. Below this critical degree of crystallization, the diffusion extent decreases only slightly with the degree of crystallization. No cationic diffusion is observed in the fully crystalline materials. The critical value might be attributed to a percolation transition from an interconnected to a disconnected glass phase. In earlier studies, we have shown that the inward diffusion approach can be used to create hard and durable surfaces on silicates glasses due to the formation of a SiO_2-rich surface layer. Therefore, the findings in this work might be used to design glass-ceramics with improved surface properties, i.e., by first making the glass crystallize to a degree below the critical value, and then making the inward diffusion occur via reduction of polyvalent ions.

Keywords: *Glass-ceramic; diffusion; diopside; percolation; surface modification; reduction*